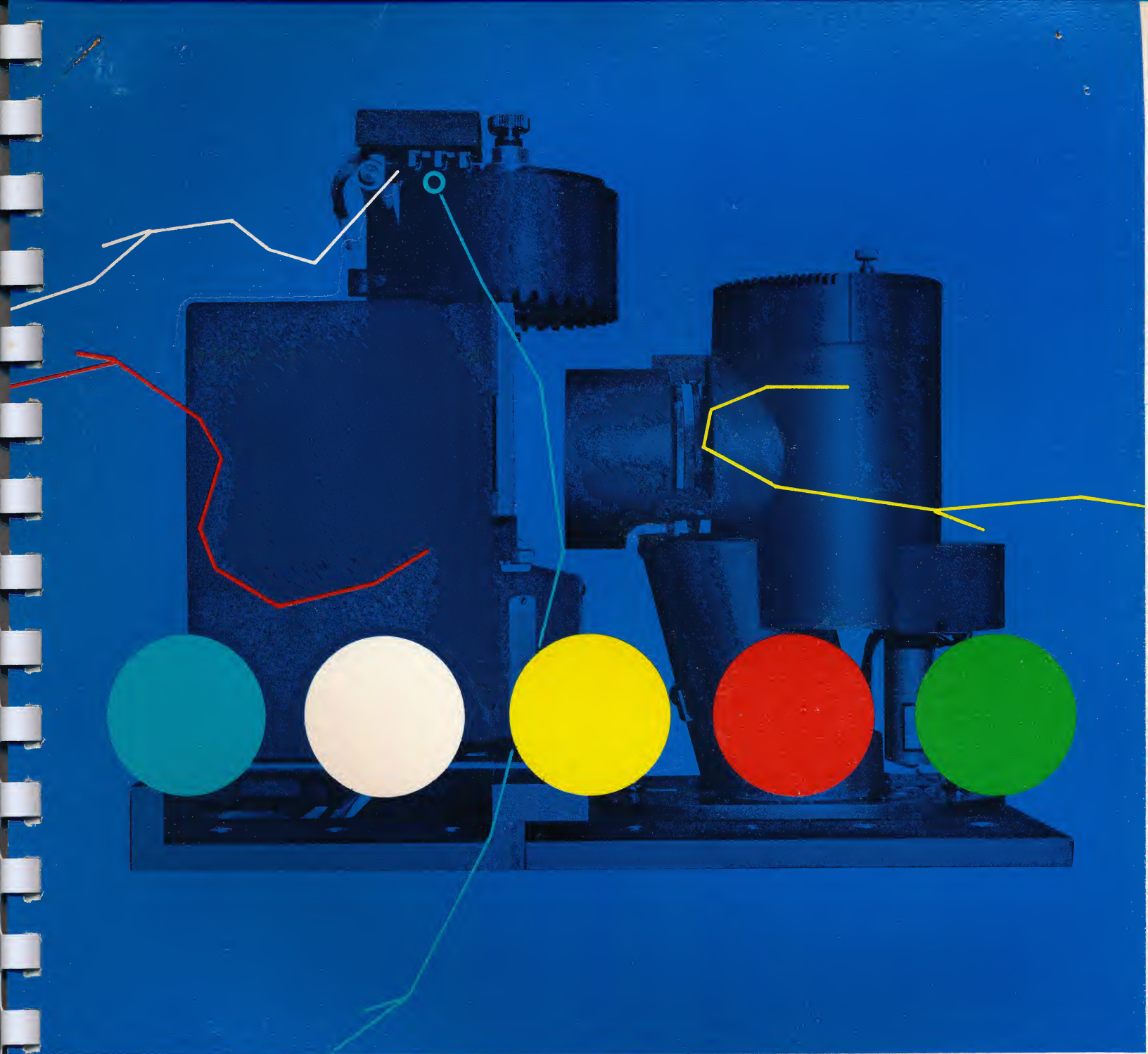




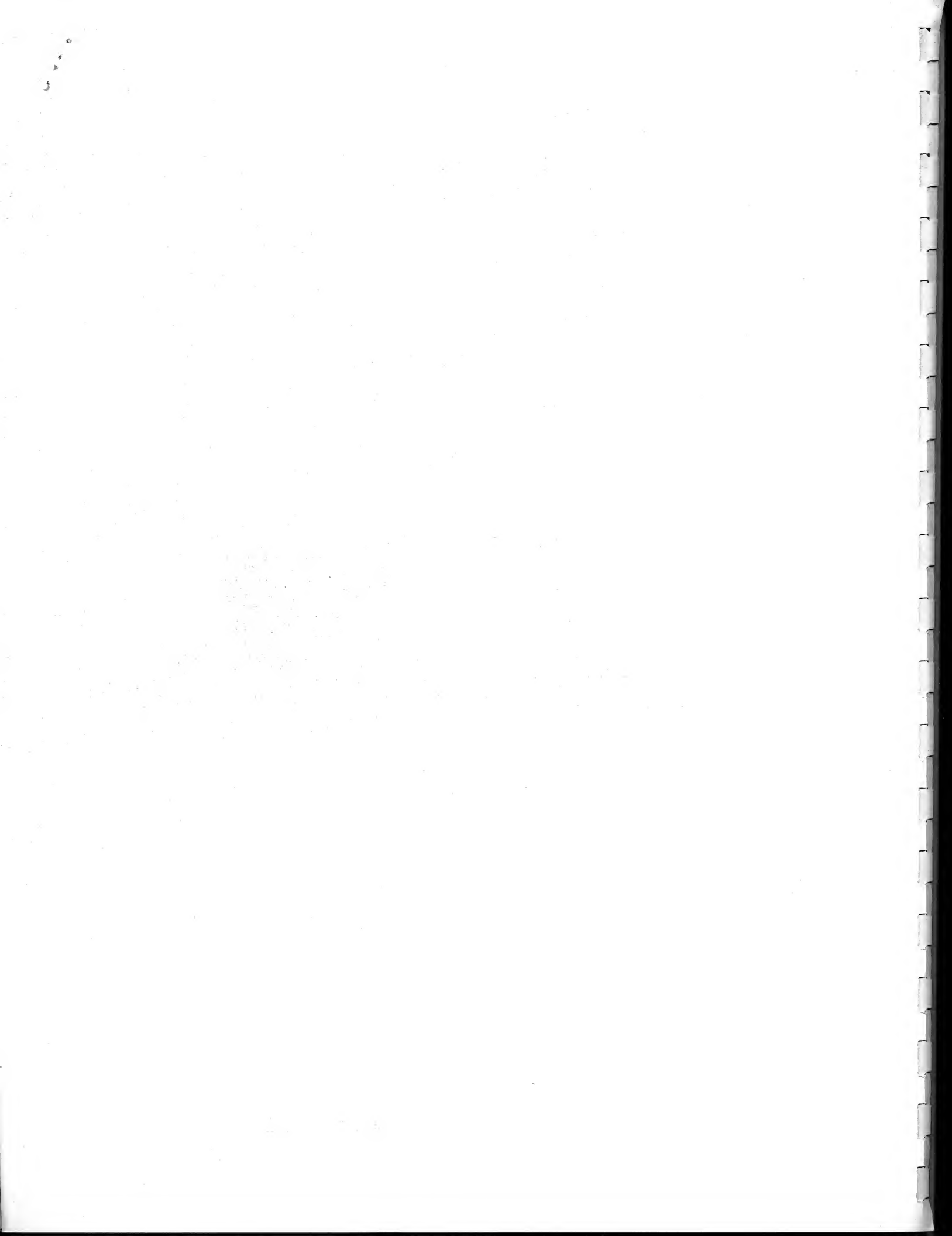
the VIGICON DISPLAY SYSTEM

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NORTHROP NORTRONICS



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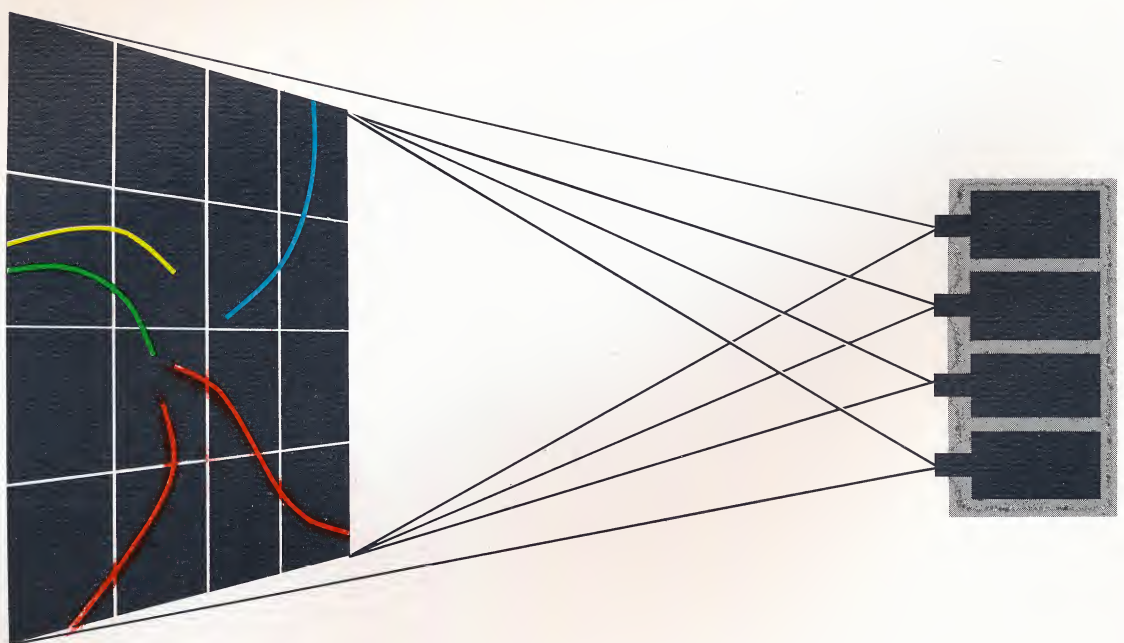
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INTRODUCTION

Decision-making functions in military operations, government, and essential industries entail such vital and far-reaching consequences today that specialized machines have become indispensable in providing necessary information to the responsible executives. Not only must the most complete, accurate, and current data be supplied; it then must be fully digested, presented in the most clearly understandable form, and exhibited continuously at the very moment the monitored events are occurring. Only then can all aspects of complex situations be viewed in their full interrelated context and analyzed with an acceptable degree of confidence.

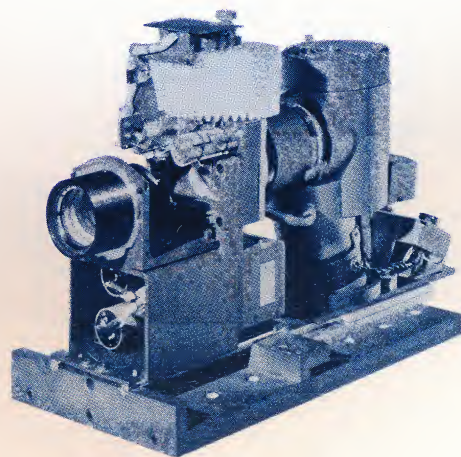
Northrop Nortronics is among the foremost suppliers in the field of information display equipment to meet these requirements. Having pioneered efficient solutions to many of the basic problems, the Nortronics Display Systems organization continues to extend the art to meet changing customer requirements and unprecedented adaptations. It has developed an array of flexible modular components, using largely solid-state circuitry, which provide proven hardware for the ever-expanding variety of applications. Nortronics conducts constant research to produce components with even greater reliability and economy.



VIGICON — ITS VERSATILITY AND SCOPE OF SERVICE

The Vigicon family of precision projectors and related components, exclusive with Northrop Nortronics, was developed expressly to meet the most exacting demands of a wide variety of display applications. In combination with appropriate auxiliary equipments, these ultracompact modular units form systems ideally suited to the extremely complex requirements of airborne, shipboard, and ground-based Command and Control Centers, for purposes ranging from localized search and rescue operations to global combat situations.

Such systems consist of three major elements -- data receiving, data processing, and data presentation. The latter is the chief concern of this brochure, but equipment of equal quality in the other two functions is implicit, since only what they furnish can be displayed. The highest order of clarity, accuracy, completeness, reliability, and speed are vital in all three if the decision-making officer or staff is to be sure the information shown is wholly trustworthy, relevant, and current to the instant.



DATA ACQUISITION

COMMUNICATION RECEIVERS AND INPUT GENERATORS

Versatility is essential in the Nortronics concept of Display Systems. This flexibility begins with the capability to utilize inputs from all manner of communications equipment, detection/transmitter devices, and selective stored-data media. Among the more common raw data sources are:

- DIGITAL AND/OR ANALOG COMPUTERS**
- DATA LINKS**
- AUTOMATIC OR MANUAL MESSAGE COMPOSERS**
- AUTOMATIC OR MANUAL DATA INSERTERS**
- GRAPHIC DATA GENERATORS**
- OTHER APPARATUS, REMOTE OR ADJACENT**

DATA PROCESSING

COMPUTERS, ANALYZERS, CONVERTERS

Versatility of the Vigicon Display System is similarly evident in the variety of data processors which may feed it. In most applications data buffers or converters are used, since final inputs to Vigicon projectors are in the form of dc analog voltages. Typical input equipments include:

- RADIO/RADAR/TELEMETER SIGNALS**
- TELEPHONIC AND VIDEO TRANSMISSIONS**
- TRANSDUCERS AND SENSORS OF MANY TYPES**
- PHOTOGRAPHIC FILMS, STRIPS, CHIPS, AND PRINTS**
- MAGNETIC, PUNCHED, AND PRINTED TAPES**
- LIBRARY CALL-UP AND SCANNING DEVICES**

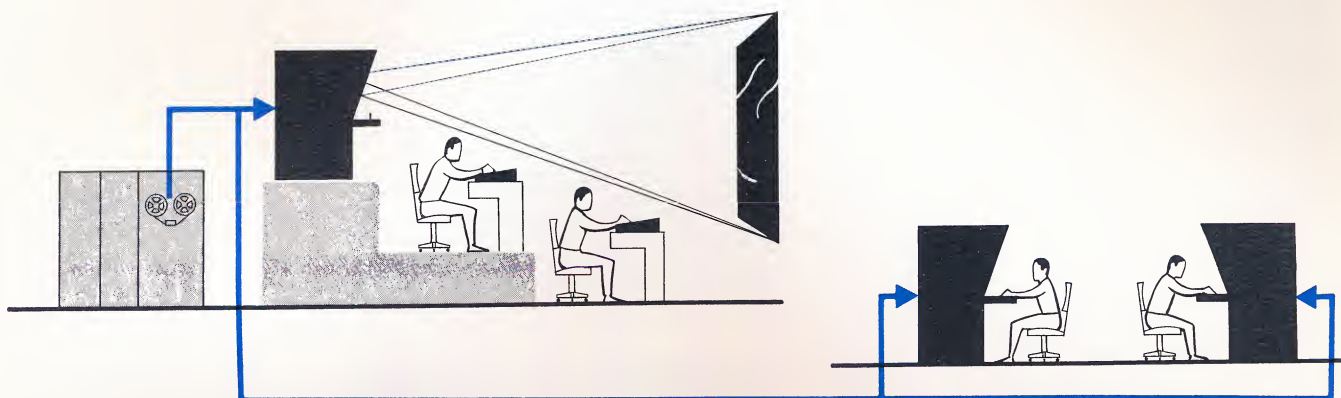
DATA PRESENTATION

DISPLAY TYPES, FEATURES, AND OPTIONS

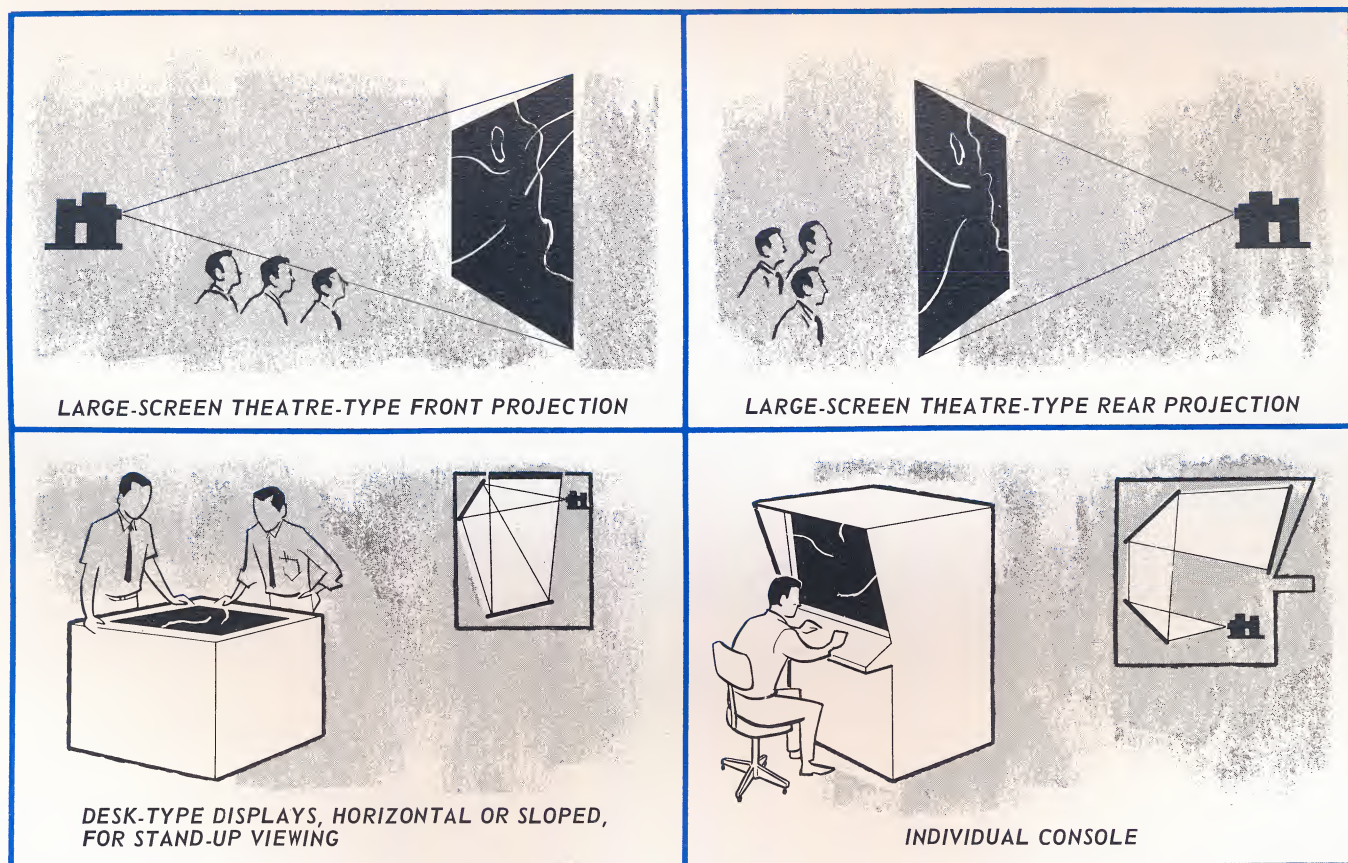
Vigicon versatility carries through also to the choice of display types and combinations, the variety of superior standard features, and the many options and adaptations available. An abbreviated itemization of these includes:

IMAGE GENERATION AND PROJECTOR TYPES. There are three basic types of projectors in the VIGICON system. Each is designed to perform a specific function. The VIGICON Plotting Projector rapidly generates any desired form of line imagery -- graphic, alphanumerics, and unlimited special symbology. The data is projected onto the screen as it is being presented to the device, requiring no preprocessing time or technique. The Reference Projector, by selecting prepared slides from a storage magazine, covers all or any desired area of the screen with background material such as charts or maps, upon which dynamic data is superimposed. The Spotting Projector, like the Plotting Projector, places dynamic data onto the screen. However, unlike the plotter, it does not leave a permanent trace, but depicts instantaneous vector position at all times. Vehicle direction as well as position can be indicated by a special adaptation which rotates the image, i.e., symbolic ship, aircraft, or submarine, to show its heading throughout its maneuverings.

DISPLAY CONFIGURATIONS. The Vigicon Display System is readily adapted to any viewing or facility requirements and in all configurations is capable of presenting highly flexible correlations of superimposed, multicolor, dynamic and static imagery. Display types most frequently used are shown on the facing page.



Theater display and two remote consoles driven by a single computer.



These may be augmented by special-purpose

STATUS BOARDS
CATHODE RAY TUBES
READOUT CONSOLES
SOUND/VOICE EQUIPMENT



COLOR. All Vigicon projectors can present data in any one of six colors by means of a 6-filter turret surrounding the light source within the projector. Color assignment is manually or remotely controlled.

MODULAR FLEXIBILITY. Numerous Vigicon projectors can be used to cast both static and dynamic images superimposed onto a common screen. A compact battery of these small-module projectors permits selective viewing of complex information by the operators and viewers. Typical situation displays may have a high density of information but the operator, wishing to study closely one aspect of the picture, perhaps that which is classified in red against the fixed reference, may do so by turning off the lamps of all plotting projectors except red. Those projectors with lamps off continue to generate data (although it is not projected) so that when lamps go on again the screen portrays up-to-the-minute data. Vigicon projectors may be stacked vertically, horizontally, or in a combination of both.

MOBILITY. Vigicon Display Systems operate in airborne, shipboard, and mobile ground applications as well as fixed-site ground installations.

LOGISTICS. Vigicon system operating costs are extremely low because expensive reproducing materials such as photographic film, process chemicals, and similar supplies are not used. Further, it is unnecessary to replace a slide when the dynamic situation changes, as in other systems. Rather, new data is added to the existing data on the same slide. Thus, relatively few slides are needed even in the most active dynamic situations.

TRUE REAL-TIME RESPONSE. Vigicon systems present a display in real time, since projection is slaved to the data source and no intermediate processing is required.

3-D DISPLAYS. Three-dimensional, multichannel, multicolor Vigicon Display Systems are available from off-the-shelf components. Since only 3-D adequately portrays many situations such as aerial maneuvers, submarine warfare, and spacecraft rendezvous, these proven systems are finding increasing interest.

Fixed or background references may be maps, grids, charts, or any desired graphic material. As many as 40 may be used and projected in any one of 6 colors.



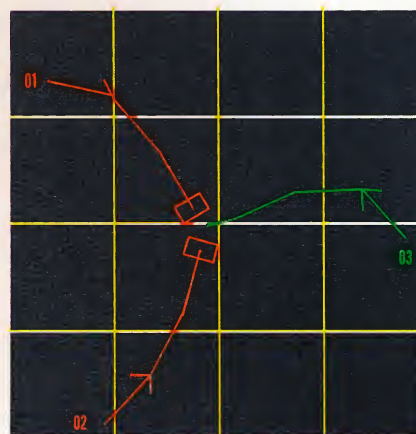
Dynamic movement or vector data is presented in real time. They may be shown in various colors or eliminated as desired.



A typical situation display may have a high density of information or the operator may select any aspect of display for closer study.



An example of selective viewing. Other information is continuously plotted with projector lights off and may be reprojected at will.



VIGICON SYSTEM COMPONENTS

There are three types of Vigicon projectors, each designed for a specific display function yet all similar in concept and construction: The Plotting Projector, the Reference Projector, and the Spotting Projector. Features and characteristics of the Plotting Projector apply to the other two, except as noted in the specific descriptions which follow.

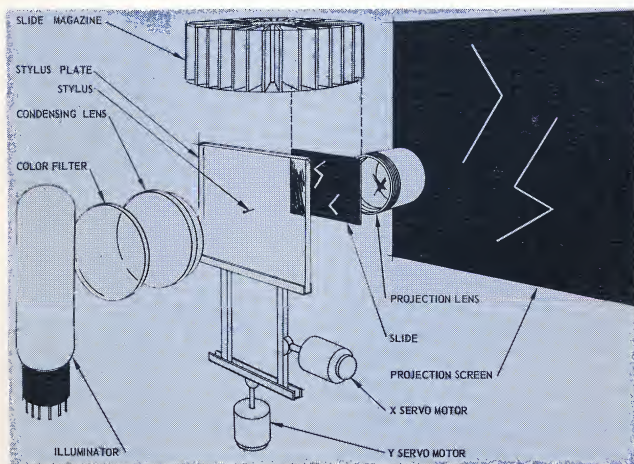
THE VIGICON PLOTTING PROJECTOR

The Vigicon Plotting Projector is a real-time plotting device capable of simultaneously projecting the images it generates. It consists of four principal functional units - light generator, slide change mechanism, X-Y servomechanism, and projection lens. Each is identified in the accompanying exploded view.

LIGHT GENERATOR AND COLOR CONTROL. The standard Vigicon light source is a projection-type incandescent lamp in a cylindrical housing. A blower (or ducted air) forces cooling air up through the housing while the lamp is illuminated. Light passes first through a heat glass to remove most of the infrared energy and protect the projector slides from extreme temperatures. The light then passes through condensing lenses to distribute the light evenly.

Automatic lamp change is provided as a reliability feature, mechanized by having two lamps on a rotating mount inside the cylinder, one active and the other a spare. Failure of the active lamp is detected by a sensing circuit, triggering a mechanism which rotates the mount and activates the spare lamp with no perceptible interruption of the display. The failure is also indicated externally so maintenance personnel will put in a new spare.

PLOTTING PROJECTOR



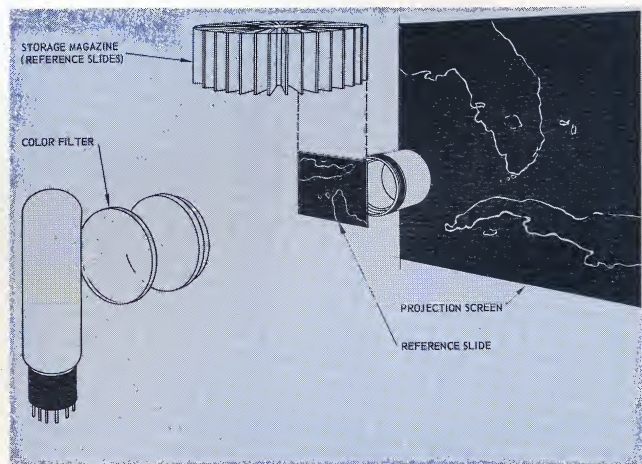
Remote control of color change, a feature unique with Vigicon, is provided by a second cylinder within the lamp housing. The color cylinder has six apertures, each with a different color dichroic filter. External control circuitry (either manual switches or computer-driven solid state) permits remote selection of any color. The cylinder rotates until the chosen filter is in the optical path. Color change is accomplished within one second.

SLIDE HANDLING MECHANISM. Vigicon slide magazines hold 40 slides. In the Vigicon Plotting Projector, slides are clear glass with an opaque coating on one face, mounted in stainless steel frames. The slide handling mechanism can retract a slide from the projector into the magazine, rotate the magazine, and insert a new slide in the projector. Control mechanization is similar to that of the color changer.

External control (manual or from a computer) can be implemented to request either random or successive selection. Manual control is used when several slides are current at the same time and information must be added to them randomly. Computer control is used when slides are plotted in sequence. An indicator shows when the last slide in the magazine is used.

PLOTTING MECHANISM. The distinguishing feature of the Vigicon Plotting Projector is the X-Y plotting mechanism. A transparent plate with a stylus at its center is mounted in the optical path. Servomechanisms, free of gearing, move it in two orthogonal directions, X and Y, and a third motion control tips it slightly forward, bringing the stylus into pressure contact with the coated surface of the slide. When the plate is in this position, its orthogonal movements cause the stylus to scribe a trace in the opaque coating. Light passes through the trace as it is scribed.

REFERENCE PROJECTOR



Lines are drawn by presenting to the servoamplifiers which control the plotter two analog voltages representing an X and a Y position. The transparent stylus plate tips back out of contact with the slide. When the carriage reaches the requested start position two new voltages are presented. The plate tips forward and is transported to the new position, scribing data which is projected onto the display. Similarly, the proper combinations of plot signals and voltages, provided by the symbol generator, cause the projector to trace and display alphanumeric or any desired symbolic images.

PROJECTION LENS. Vigicon projectors are equipped with low-distortion optical lenses for best possible definition of the projected display. Adjustments are provided to focus and translate the lens. Several sizes and focal lengths are available to fit the combination of display size and throw distance for virtually any system.

THE VIGICON REFERENCE PROJECTOR

The Vigicon Reference Projector is identical to the Plotting Projector except that the modular plotting mechanism is absent. In this case, the magazine stores prepared slides bearing reference material such as maps, profiles, compass roses, and diagrams. This projector's function is to select requested slides and present them on the screen as backgrounds upon which plotted information from the plotting projector is superimposed.

THE VIGICON SPOTTING PROJECTOR

In the Vigicon Spotting Projector there is no slide change mechanism and, on the X-Y servo carriage, the stylus plate is replaced by a special

slide bearing any desired symbol. Appropriate signals to the servoamplifiers can drive the symbol to any position on the display.

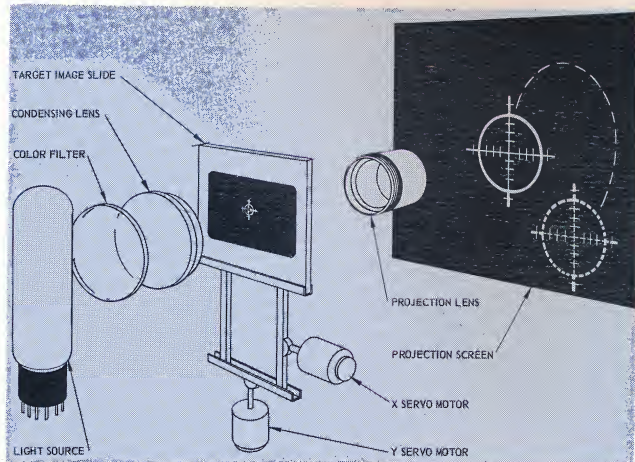
There are numerous uses for such a projector in a display system. In a naval tactical display, for example, it may present the ship's present position, continually updated. It is sometimes desirable to know the coordinates of a given point on the display. In such case the position of the spot is manually controlled to place it on the point of interest. Digital encoders, driven in parallel with the servo feedback potentiometers, then will provide a readout of the coordinates of that point.

Many applications connect a spotting and a plotting projector in parallel. To enter alphanumeric data at an exact point on the display, the operator directs the spot to that point and uses a manual keyboard to place the data there through the off-line plotting projector. In an air traffic control system the plotting projector could trace an aircraft's course while the color of the spot, following the point of the trace, could be used to encode its altitude.

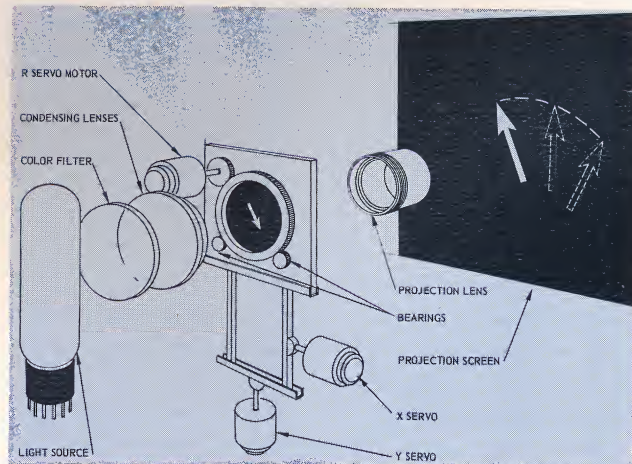
ROTATING SPOTTING PROJECTOR

A special type of spotting projector has the added capability of rotating the symbol plate. Thus, on the display, the symbol can indicate a craft's heading as well as its position. In the Rotating Spotting Projector a third servo system connected to the X-Y carriage rotates the mounting in which the symbol plate is held.

SPOTTING PROJECTOR

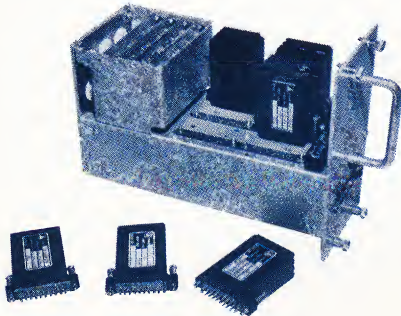


ROTATING SPOTTING PROJECTOR



ASSOCIATED PROJECTOR ELECTRONICS

Electronic equipment associated with the Vigicon System includes a Dual Servoamplifier, a Lamp Switch Control unit, and a Slide Changer Sequencer.



DUAL SERVOAMPLIFIER

Each Vigicon Plotting Projector is operated by a Dual Servoamplifier unit consisting of X-axis and Y-axis servoamplifiers powered by regulated dc (+28 and -28 volts) and ac (26 volts rms at 2 kc). Electrical features include a damping circuit to assure rapid response without excessive overshoot and a protection circuit to limit the period during which the servoamplifiers can deliver full power to the servomotors.

The Dual Servoamplifier is composed of six plug-in welded modules: one dual channel buffer, one dual channel demodulator, two dc amplifiers, and two ac amplifiers. These are mounted with various other components on a single chassis. Dimensions of each welded module are $3/4$ by $1-1/4$ by $2-1/2$ inches. The dual unit is $6-5/8$ inches high, $3-29/32$ inches wide, and 9 inches deep. Four dual units can be mounted in a standard 19-inch rack.

LAMP SWITCH CONTROL

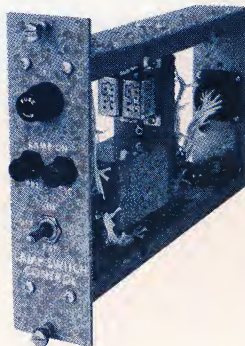
The Lamp Switch Control (LSC) unit is used to apply 115-volt ac power to either of the two projection lamps, to sense failure of the primary lamp, to activate a remote "lamp fail" indicator, and to switch power from the primary to the secondary lamp. The unit consists of two relays, a transformer, miscellaneous circuit components, and a front panel; two indicator lamps on the front panel denote which projection lamp is in operating position, and a 3-position toggle switch is used to select local or remote control of the lamp function. Eight LSC units, each measuring $6-5/8$ by $1-15/16$ by 9 inches, can be mounted in a Vigicon standard equipment chassis.



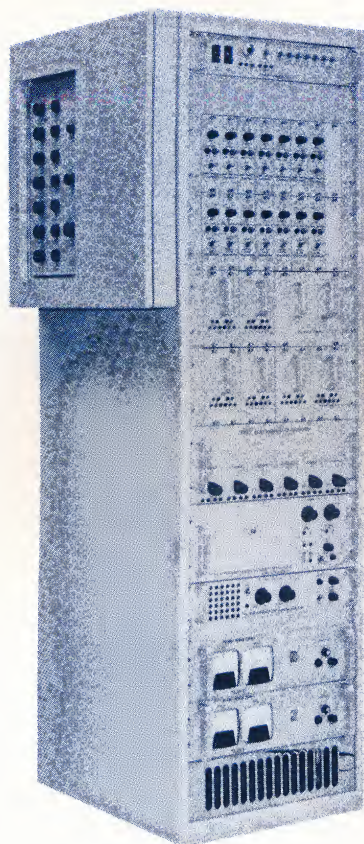
SLIDE CHANGE SEQUENCER

The Slide Change Sequencer (SCS) controls the voltages to the projector slide change motor and solenoid for operation of the slide change cycle in either sequential or random select mode. In the sequential mode, the SCS initiates a slide change on receipt of a slide change pulse that is long enough to start the cycle without causing more than one slide to be extracted from the magazine. (Nortronics generates the required pulse on the basis of customer-furnished slide change commands.) In the random slide select mode, the magazine continues to rotate until the requested position is found; the input required is a 6-bit binary word. Position coding may be included in a computer instruction repertoire or may be selected manually through a multiposition selector switch.

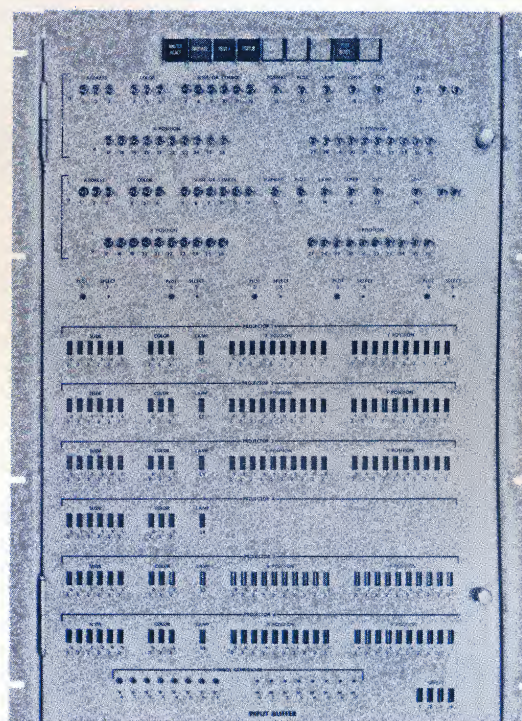
The SCS consists of single package containing nine reed-type relays mounted on printed circuit cards and a front panel providing a switch and indicator light to facilitate magazine change on the associated projector. Eight SCS units will plug into a Vigicon standard equipment chassis, which occupies 7 inches of panel space in a standard 19-inch equipment rack.



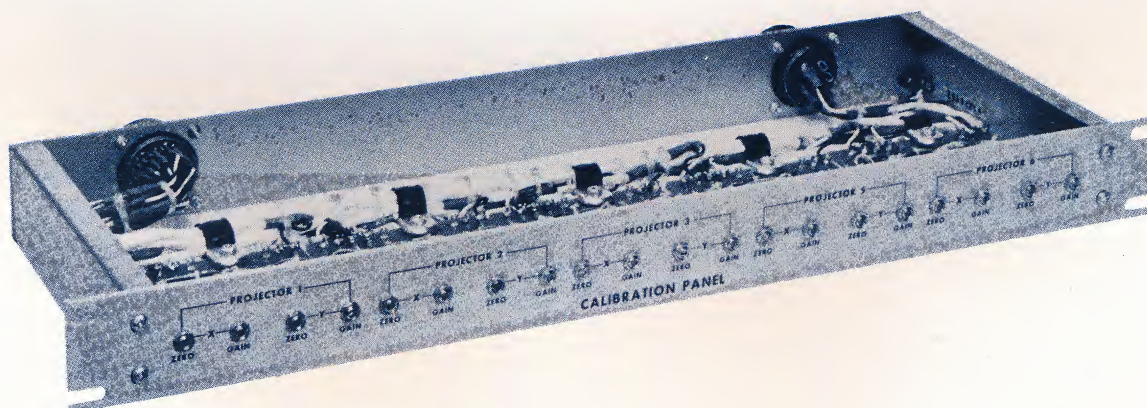
ADDITIONAL SYSTEMS EQUIPMENT



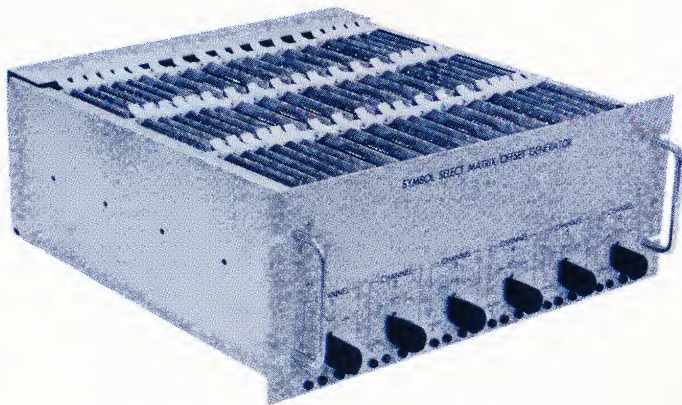
RACKS



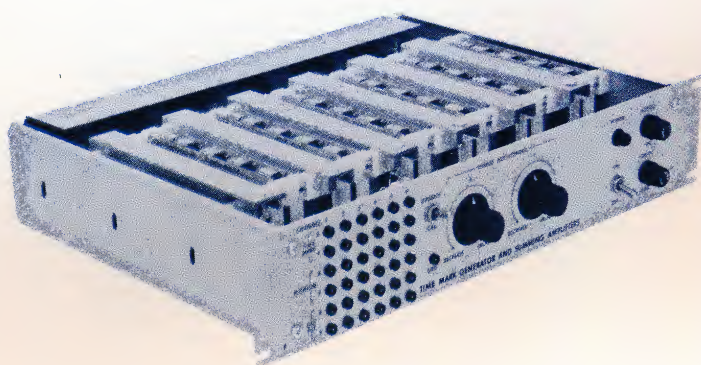
BUFFERS



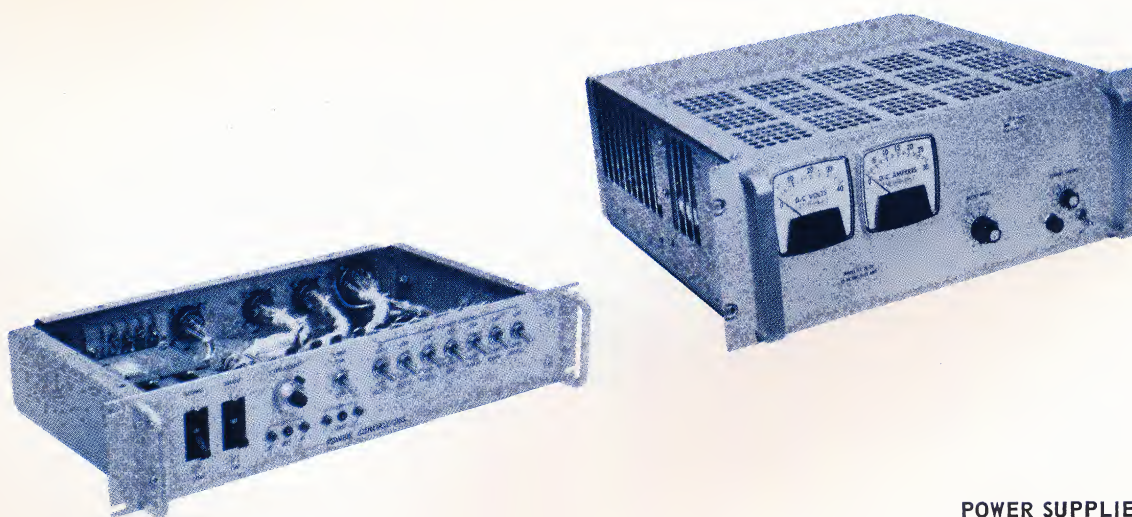
CALIBRATION



SYMBOL SELECT MATRIX



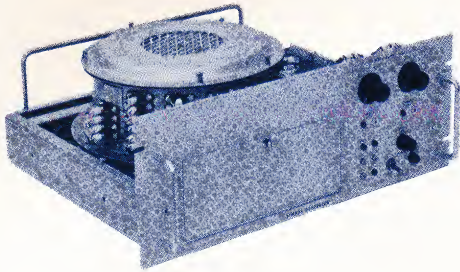
SPECIAL GENERATORS



POWER SUPPLIES

PERIPHERAL EQUIPMENT

Nortronics has designed and produced a variety of peripheral equipment for use with the Vigicon System, including a Symbol Generator, a Tracing Unit, and a number of custom-built items to meet specific customer requirements.



SYMBOL GENERATOR

The Symbol Generator produces X and Y analog symbol voltages for up to 64-symbol capability. The following technique is employed:

A film negative fastened to a transparent drum is rotated between a light source and a photodiode. Variations in the aperture size regulate the amount of light passing through the negative and impinging on the photodiode, resulting in directly proportional variations in the analog voltage produced by the photodiode. A trimpot is connected to the output of each photodiode to compensate for inequalities in the light sources. Power for the light sources and the drum-rotation motor is +28 vdc at 3 amps.

Three additional photodiodes are used to generate three symbol timing functions: start of symbol, end of symbol, and projector plot. The outputs of these photodiodes are routed to three Schmitt triggers, each of which produces a 28-vdc relay drive signal. The plot signal in turn drives a power amplifier, the output of which is used to drive the projector plot solenoids.

The Symbol Generator is packaged in modular form. Three X and three Y symbol channels are provided on a single drum. Symbols can be added or replaced with other symbol patterns in a few minutes. Panel height is 8-3/4 inches and the unit is mounted in a standard 19-inch rack.

SPECIAL UNITS

Nortronics can supply status boards, message composers, readout consoles, control keyboards, and other specialized peripheral equipment to meet individual customer requirements for Vigicon Display Systems. Such equipment is designed and built to customer specifications.



VIGICON TRACING UNIT

The Vigicon Tracing Unit provides a means of inserting graphic or alphanumeric information in color, either permanently or temporarily, onto projector slides for display on a screen. This unique device incorporates an electronic tracing pencil, or pantograph, with which the operator can transfer maps, charts, designs, and other printed or original material directly to the projected display. By means of a special keyboard the operator can also call for alphanumeric or special characters, supplied by the Symbol Generator, to be plotted at a point indicated by the tracing pencil. The Tracing Unit can thus serve as a highly satisfactory backup system in case of computer failure.

Mechanically and electronically, the Vigicon Tracing Unit is a remarkable simple apparatus. It consists of a standard tracing table, the tracing pencil and rod, a tracking ball, a support arm and base, and a plot signal switch operated by a thumb button or foot treadle. The tracing table work area accommodates drawn or printed material up to 30 inches square.

The tracing pencil rod is suspended over the center of the work area from the tracking ball and mechanically linked (30-to-1 ratio) to an X-Y tracking assembly inside the ball. Deflections of the tracing rod in X and Y, detected in the tracking assembly, are transmitted as output X and Y analog voltage signals to a central control panel for distribution to the associated Vigicon Plotting Projector. Each output is adjusted for display screen centering and scale factor by potentiometers in the base of the support arm. Scribing of the projector slides is controlled by depressing and releasing the plot signal switch while tracing is in progress.

VIGICON PROJECTOR CHARACTERISTICS / SPECIFICATIONS

DIMENSIONS	15-1/2" L x 4" W x 11" H (Allows for projector mounting on 4-inch centers)
WEIGHT	15 pounds
INPUT X-Y LEVELS	± 1 or 0-2 volts <u>minimum</u> for full scale of screen size
FREQUENCY RESPONSE FOR MINIMUM SIGNALS (1% FULL SCALE AS IN SYMBOL GENERATION)	100 cycles per second
STYLUS SLEW TIME	100 or less milliseconds (full scale)
STYLUS RESPONSE TIME:	
In Plot	15 milliseconds
Out of Plot	5 milliseconds
STYLUS POSITIONING:	
Accuracy	$\pm 0.13\%$ (full scale) (standard); $\pm 0.07\%$ (full scale) (optional)
Resolution	Essentially infinite
Repeatability	$\pm 0.03\%$ (full scale)
STYLUS TRACE WIDTH	0.10% $\pm 0.03\%$ (full scale)
SLIDES:	
Construction	1-1/2" x 2" metal frame
Configuration	Special hook for positive indexing, jamproof handling
Special Features	Thin thermal-resistant glass, lightweight
SLIDE MAGAZINE:	
Construction	4" circular precision-molded high-impact plastic
Capacity	40 slides
Special Features	Slides positively held; slide positions numbered for reference; ideal shipping & handling container
Selection	Manual, automatic, remote, or computer control
COLOR:	
Capability	Filter turret; six colors for optimum viewing
Time to Adjacent Color	250 milliseconds
Time to Any Color	1 second (max)
Selection	Manual, automatic, remote, or computer control

SLIDE CHANGER:

Operation Sequential or random slide selection; remote selection capability

Slide Indexing (Reposition Accuracy) $\pm 0.02\%$ (full scale)

Time to Adjacent Slide (Sequential) 650 milliseconds (standard)

Time to Each Subsequent Slide Position (Random) 165 milliseconds (standard)

Special Features Shutter interlock to block light during slide removal; anti-jam design of mechanism

MECHANICAL ACCURACY

(IMAGE OVERLAY OF

MULTIPLE PROJECTORS) $\pm 0.05\%$ (full scale)

TOTAL SYSTEM ACCURACY 0.2% of screen size (Standard)

ILLUMINATOR:

Lamp Types (Standard) 300- 500- 750- 1000- 1200-watt incandescent

Lamp Types (Special) Xenon light source

Lamp Life (Standard) 25 - 200 hours

Light Intensity 3000 lumens (max) at 1" x 1" object plane

Automatic Lamp Change Spare lamp for uninterrupted operation

Time to Switch to Spare Lamp 500 milliseconds

Adjustment Rotary alignment for off-axis operation

COOLING (OPTIONAL) Blower packaged as part of light source housing; 28 vdc or 115 v 60-cycle operation

PROJECTION:

Screen Sizes 15 in. x 15 in. to 20 ft x 20 ft

Methods Front, rear, or folded optics console

Lens Translation $1/2$ angle of 25°

Lens Distortion (Differential) $\pm 0.05\%$

Optical Field Angle 50°

Standard Focal Length (mm) 50.8 $\pm 1\%$ and 75 $\pm 1\%$

SYMBOL GENERATION:

Random 4 per second

Adjacent 6 per second.

Multiplex Dots 10 per second

VIGICON DISPLAY SYSTEM APPLICATIONS

Experience continues to demonstrate the superiority of real-time dynamic/static displays in providing integrated situation information to large staffs, to small groups, and/or in break-outs to individual specialists. Here the full situation is seen by all concerned, in the form which all can readily comprehend; each can act upon his own area of responsibility, observing the effects of his decisions within the full context of the overall problem.

In various lines of military, space, governmental, and industrial activity a number of impressive installations already are in service, more are under active consideration -- and in many more places such systems are urgently needed. Following paragraphs cite only a few generalized examples of recommended applications.

LOGISTICS AND CIVIL DEFENSE

- INDUSTRIAL/MILITARY LOGISTICS
- DAMAGE ASSESSMENT
- RELIEF AND EVALUATION
- PERSONNEL AND ASSIGNMENTS
- FACILITIES AND MANPOWER REDEPLOYMENT
- RESOURCES STATUS
- VITAL RECORDS COORDINATION
- RADIOACTIVITY PATTERNS
- OTHER CONTINUING DANGER AREAS

Adequate civil defense provisions will include a communications system of continental scope with a network of control centers. Present hardened sites may be augmented by mobile or perhaps airborne centers. Each must gather and display current data on population and all types of resources to determine the results of an attack, real or simulated, based on existing or hypothetical conditions, static and dynamic.

The Vigicon displayed information will permit the coordination and expediting of numerous activities, including evacuation, decontamination, rescue and relief, salvage of resources, and restoration of civil and industrial facilities.

MILITARY

- SUPREME COMMAND
- STRATEGIC AND TACTICAL COMMAND
- AIR DEFENSE
- ANTI-MISSILE MEASURES
- NAVAL OPERATIONS
- ANTISUBMARINE WARFARE
- MOBILE LAND/AMPHIBIOUS OPERATIONS
- WEAPONS CONTROL
- DRONE CONTROL
- RANGE SAFETY
- EXERCISE MANEUVERS AND WAR GAMES
- INTELLIGENCE REPORTING AND EVALUATION
- BATTLE THEORY, PLANNING, ALTERNATIVES EVALUATION

To present battle situations and other widespread commitments of forces, an information display is generally of ample size for viewing by a fairly large audience. Information complexity usually requires color and clear but simple annotations. Inputs may be derived from such diverse sources as early warning radars, picket ships, visual observation reports, intercepts, airborne radars, and contiguous radar stations and communication bases.

After computer processing, the integrated data is presented on appropriate displays. For most military purposes these must be in real time and extremely accurate, not alone as the basis for effective and expeditious action but also to avoid neutral territory violations, inadvertent casualties, and waste of vital resources.

Reference background matter, relatively static compared to the surveillance data, must be readily augmentable or replaceable as well as instantly removable to avoid accumulation of outdated or unneeded information on the display.

In many of these applications it is also important to be able to make rapid, drastic variations in the scale of both dynamic and static matter simultaneously, for close-up study of the details in a specific area or to expand the range of the display by several magnitudes.

The Vigicon system excels in all these features.

FIRE AND POLICE

**MAJOR FIRES
RIOTS AND CIVIL DISORDERS
NATURAL DISASTERS
MANHUNTS
SEARCH AND RESCUE OPERATIONS**

Requirements for the command and control of fire and police functions are similar, on a more localized basis, to those described for civil defense and military operations. Vigicon offers efficient and economical displays to satisfy the specific needs of civil authorities, with built-in capabilities for flexible growth.

TRAFFIC CONTROL

**CIVIL AND MILITARY AVIATION
URBAN AND HIGHWAY
TRANSIT AND RAILROAD
HARBORS, CANALS, AND COASTWISE SHIPPING**

Proper air traffic control provides both terminal and midcourse coverage. Each aircraft must be displayed in flight profile, horizontal and vertical, and monitored in real time relative to all others in the same area. Aircraft approaching the terminal phase must be displayed on another screen, on a larger scale, where their positions can be monitored for landing in relationship to all factors in the terminal area.

The higher speed and volume of traffic of all types today call for adequate control systems with comprehensive real-time information displays. For water, rail, and motor vehicle traffic, the information may be gathered by combinations of radar, aerial observations, rate counters, and various automatic detector relays.

The Vigicon display translates the processed data into active displays which permit the human controllers to make better and faster decisions than those derived from printed matter or tabulation boards. Graphic, alphanumeric, and other information may be selectively added or removed to emphasize items of particular interest at given times.

SPACE

**MISSILE TRAJECTORY STUDIES
ORBITAL AND INTERPLANETARY VEHICLE TRACKING
SPACECRAFT RENDEZVOUS MISSION CONTROL**

Both in military R&D and for scientific purposes, there is need for continuous observation of the precise course and inflight performance of test missiles, satellites, and spacecraft. Also the increasing number of vehicles and derelicts in outer space calls for the ability to display upon command all or any of the craft, identified by type, current location, nationality, orbit characteristics, predicted life, and other pertinent data.

Adequate control of vehicle attitude, course, speed, onboard instrumentation and communications equipment on scheduled and contemplated unmanned exploration missions requires visual observation of all programmed operations and responses to commands, and comparison of predicted with actual performance. Likewise, a high order of displays is required for satisfactory liaison with the vehicle and astronauts on such programs as Mercury and Apollo, and in future orbital platform assembly and multicraft rendezvous operations.

For all these applications, data must be processed by special-purpose or specially programmed computers and the displays must present information in real time, with facilities for showing future or past conditions, color, and extremely flexible use of annotations. Some of these systems also will have 3-D capabilities and access to vast magazines for call-up of reference backgrounds and data. Here again, Vigicon equipment can meet the requirements.

WEATHER PLOTTING

**METEOROLOGICAL CENTERS
MAP GENERATION
LONG-FILE TRANSMISSION AND DISPLAY
AIR POLLUTION CONTROL AND ALERTING**

Latest data on weather conditions and prospects is necessary to military and civil aviation for best utilization of equipment, maximum safety, and reduced flying time. It is also needed by other government agencies, agriculture, and certain industries. An accurate display system, which requires minimum data transmission characteristics and time, is available using Vigicon components and proven auxiliaries. Color is useful, among other things, in differentiating isobars from isotherms.

NAVIGATION AIDS

**MERCHANT MARINE, NAVY, AND AIRBORNE
CRAFT'S OWN POSITION DISPLAYS
COMPUTER-GENERATED MAPS**

The Vigicon system is adaptable to a wide range of navigational aids for airborne and shipboard use, aside from the military context discussed earlier. The craft's position can be plotted as a point or a course trace, displaying "own position" as the center in relation to other moving objects and fixed points or, alternatively, it may be shown as a trace or symbol superimposed on a map with other items of interest correspondingly positioned and annotated. Inputs may be from digital or analog computers, manually operated keyboards, teletype, and other communications media.

Backgrounds for weather, navigational channels, stationary hazards, etc., may be drawn onto the display by an alphanumeric-graphic inserter. Scale is variable and portions of the display may be added or removed as desired. The display can plot intercept problems (as in coast guard and customs activity) or collision avoidance courses. Elimination of old track history can be automatic or operator controlled, in either case retained for possible review later.

SIMULATORS

**AIRCRAFT/SPACECRAFT COCKPIT SITUATION DISPLAYS
ANTISUBMARINE WARFARE TRAINERS
MACHINE OPERATOR TESTS**

Vigicon is adaptable to numerous types of simulators with widely varying display sizes and requirements. Most simulators are used in the training of personnel for optimum utilization of vehicles or weapons under hypothetical conditions. Normally the situation facing the student is inserted by an instructor who then monitors student reaction. A visual display is required for both people. The displays may be alike or different. Upon completion of an exercise it is important that the instructor give the student an exact playback for critique purposes.

The very nature of the Vigicon system concept provides the advantage of a built-in simulator for operational systems. This is accomplished by the ability to replay operational exercise for critique purposes.

INDUSTRIAL / COMMERCIAL

**PROCESS CONTROL
MATERIALS FLOW
INVENTORY AND SUPPLY SYSTEMS
STOCK MARKET CHARTING**

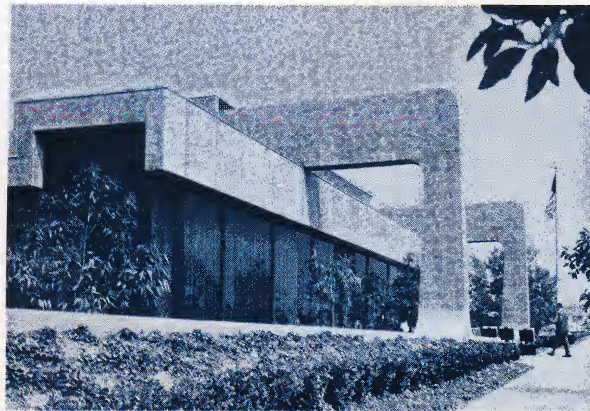
In such widespread complexes as powerplants, nuclear reactors, smelters, oil refineries, chemical processing plants, and pipeline systems, an integrated multicolor display provides a current and complete picture of equipment and process status. Vigicon display systems eliminate monitoring multiple gages and pen-ink plotters. Furthermore, data is extremely accurate, comprehensive, and can be retained permanently for analysis. The compact Vigicon system can present extensive information in a small area, whereas other systems require large wall or floor space.

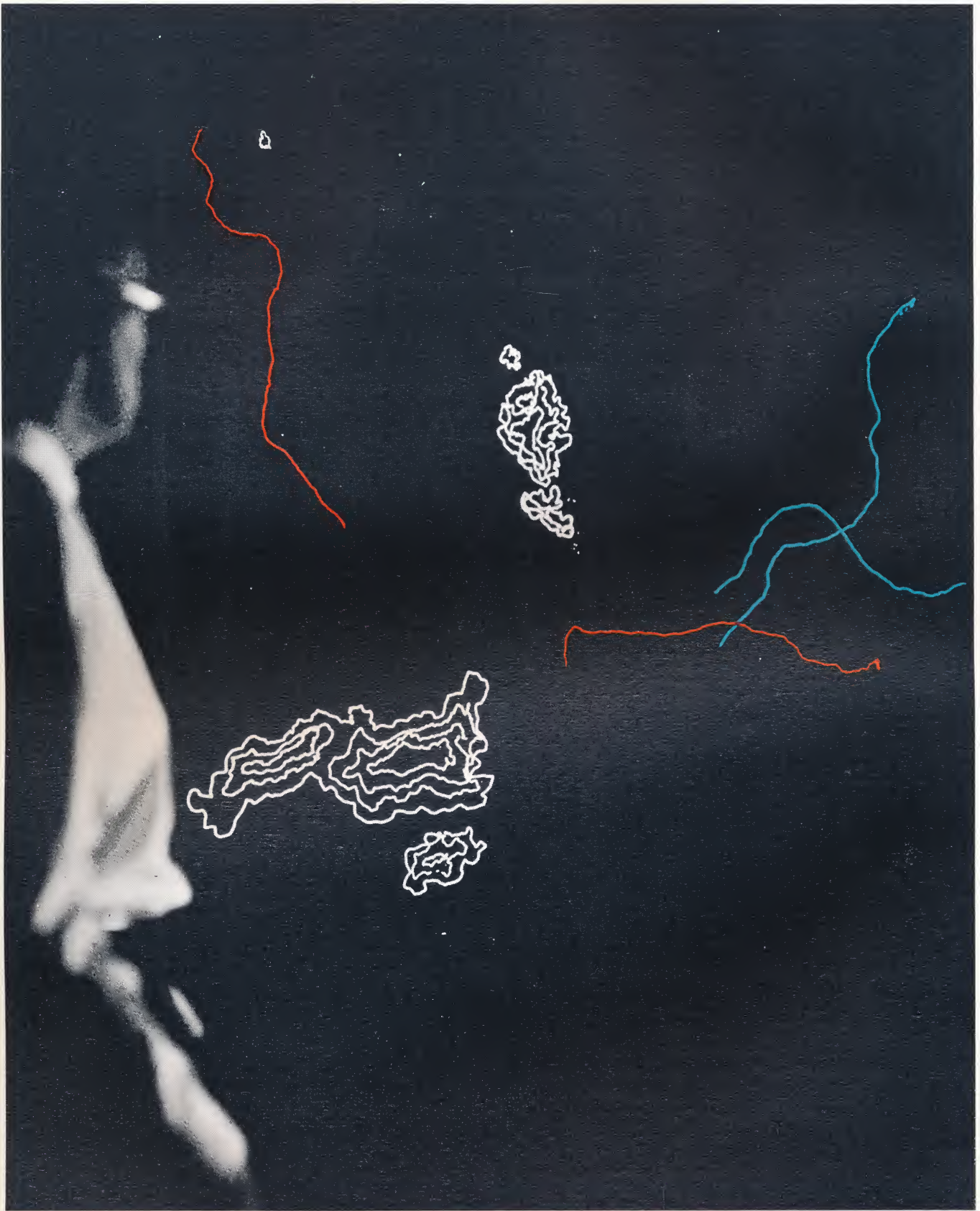
CAPABILITIES

NORTHROP CORPORATION is a diversified, systems oriented company engaged in the research, development and production of advanced scientific and technological products for Free World defense and space programs. As a prime systems manager, Northrop provides economical solutions to a broad spectrum of complex technical problems. In an associate relationship the company fashions its capabilities for efficient integration with those of other organizations at work on large national programs.

Northrop is composed of three divisions, Northrop Space Laboratories, three wholly owned subsidiaries and several companies. These organizations and their activities are solidly built around fundamental technical capabilities, rather than along straight product lines. This is the structure that Northrop has devised to apply its varied capabilities in a way that will produce the maximum yields in results, at the lowest effective cost, delivered on time.

One of the three divisions, Northrop Nortronics, is devoted to design, development and manufacture of electronic, electromechanical, ordnance, precision optical and opto-electronic products, components and systems. It is the most diversified of all Northrop divisions in terms of products. More than 5,000 people are employed in over 1,200,000 square feet of assembly areas, offices and laboratories in Southern California and Massachusetts.





EXPERIENCE

Nortronics has a long history of successful research, development, and manufacture in the various aspects of Display Systems for aircraft, space, naval, and military operations centers. It has grown out of the Division's 17 years of traditional concentration on data acquisition, data transmission, data processing, and data presentation. Many types of sensors, transmitters, and computers, both general-purpose and highly specialized, have been produced, as well as a variety of display subsystems including photometric equipment, comparators, viewers, sky screen, and CRT presentations. Development of the Vigicon family of ultracompact, automated projectors and accessories is a major result of this broad background in devising hardware to obtain,

refine, and convey complex information for prompt assimilation and utilization.

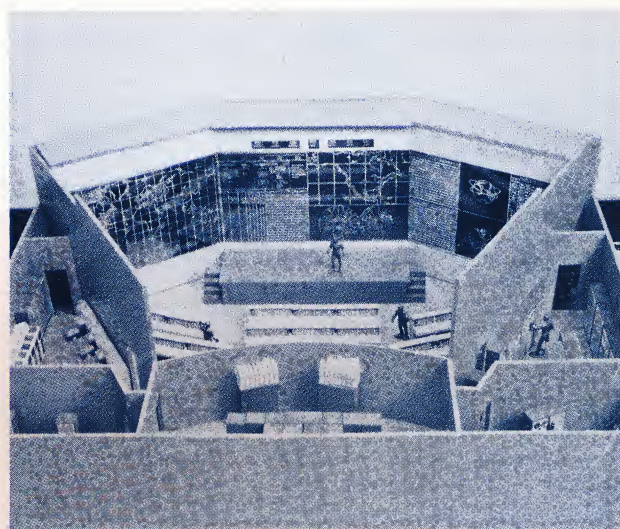
Recognizing that displays had become a discrete technology, Nortronics established a Display Systems organization in 1960 to serve the increasing number and magnitude of requirements for control center display equipment. Top talents were assembled from all facets of the display systems field.

The current record of accomplishment includes contracted studies and delivery of display systems utilizing off-the-shelf hardware for the following projects:

Project: PS-7990-21 Aerospace Surveillance Planning Study for the 1970-1975 Period
Customer: Air Force, Electronic Systems Division
User: 496L SPO

This classified study involved all of the aspects of a worldwide aerospace surveillance network of sensors, communication links, data processors, and displays producing a vast quantity of data at the NORAD Surveillance Center. Critical and timely information from these data sources must be given to several military and civilian agencies which are engaged in counterstrike activities and the defense of the United States.

Nortronics developed the concept of the Surveillance Center and its position and use in the Aerospace Surveillance System. Operation and implementation of the Center as an integrated part of the system were developed and reported in ESD TDR 62-299, Volume VIII. The equipments, their operation, and the duties of operating personnel were analyzed and described. Recommended methods of operation were considered in detail.



Project: Satellite Tracking Annex Study
Customer: Lockheed Missile and Space Company
User: Air Force

This study involved the evaluation of the existing display and command-control requirements and recommendations for advanced satellite system.



Project: Norfolk Anti-Submarine Warfare Task Force Simulator, Device 14A6
 Customer: Lockheed Electronics Company, Plainfield, N. J.
 User: U. S. Naval Training Device Center, Norfolk, Va.

This contract award covered the design and delivery of a forward-projection display subsystem consisting of large-screen presentations for the U.S. Navy Anti-Submarine Warfare (ASW) School at Norfolk, Virginia. This subsystem requires the conversion of the simulator's data processor digital and analog data outputs into a large, dynamic, graphic presentation, depicting the instantaneous positions of multiple tracks, along with pertinent annotations, on three 10-by-10-foot screens. The tracks are displayed in real time and in multiple colors, the latter for the purpose of distinguishing between aircraft, surface, and subsurface vessels. The efforts required in this display subsystem included system analysis, design, integration and fabrication. The design of special-purpose electronic equipment was also involved.

Project: San Diego Anti-Submarine Warfare Task Force Simulator, Device 14A6
 Customer: Lockheed Electronics Company, Plainfield, N. J.
 User: U. S. Naval Training Device Center, San Diego, Calif.

This is a follow-on contract for a display subsystem identical to the Norfolk ASW Simulator, to be installed in the San Diego ASW School for Pacific Fleet Task Force training.



Project: Eastern Test Range (ETR) Trajectory Display
 Customer: Sperry Piedmont, Charlottesville, Va.
 User: Air Force

This contract provided for the Trajectory Display equipment to trace movements of missiles and/or satellites at the ETR Control Center at Cape Kennedy. The new range control center is designed to provide improved and expanded control for the various elements which comprise the ETR. It also serves as a mission control center for global tracking operations and orbital missions such as Gemini and Apollo. The system displays dynamic movement of as many as four different space vehicle trajectories or orbital plots in a real-time sequence. This presentation is a rear-projection system utilizing an 8-by-8-foot screen.



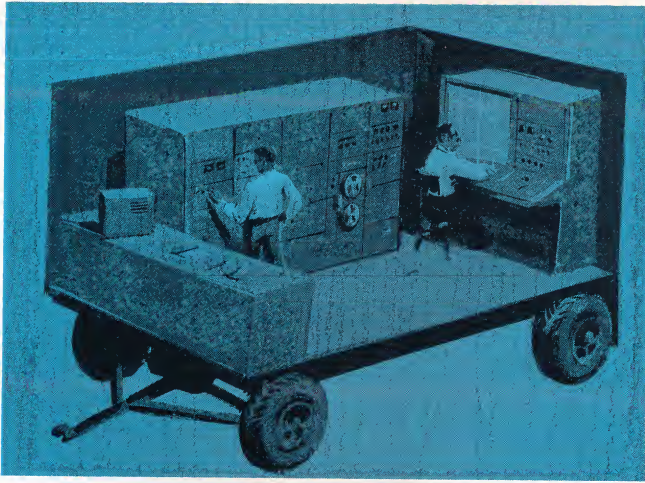
Project: SH-2 ASW Helicopter Crew Trainer, Device 2F64A
 Customer: Melpar, Inc., Falls Church, Va.
 User: U. S. Naval Training Device Center

This contract is for four identical display systems, each to include a self-enclosed console which utilizes folded optics and mirrors to portray on a 30-by-30-inch screen the movements of the SH-2 helicopters and various targets in flight. The system is an instructor's aid in verification and evaluation of commands to the airborne vehicles. The display interfaces with a digital computer as the data link and is installed in a mobile trailer for operational flexibility.



Project: Gemini/Apollo Mission Analysis Display
 Customer: IBM, Kingston, N. Y.
 User: NASA

Nortronics was awarded this contract to provide the Mission Analysis Display equipment to trace the maneuvers of Gemini and Apollo spacecraft. The display system presents dynamic movement of the space vehicle trajectories or orbital plots, as defined by an IBM complex of computers, in a real-time sequence. This presentation is a rear-projection system utilizing a 6-by-6-foot screen. It will be installed and operated at Goddard Space Flight Center.



Project: Gemini/Apollo Terminal Land-
ing System
Customer: Philco Corporation, Houston,
Texas
User: NASA

This contract is to provide the Terminal Landing Display Subsystem for the NASA Manned Space Flight Center, Houston, Texas. The purpose of the system is to analyze and subsequently select the optimum recovery system for Gemini/Apollo spacecraft. The display, recording and presenting the attitude, altitude and position of spacecraft during the reentry phase of the mission, will be portrayed on two 15-inch square screens by utilizing mirrors to fold the optics. The system, as installed in a trailer/van, is air transportable and ground mobile.

VIGICON SYSTEM DEMONSTRATION



A Vigicon system is available for demonstration at Research Park, Palos Verdes Peninsula, California. In this demonstration five Vigicon projector channels are driven to simulate system conditions and to display characteristics such as real time, high resolution, accuracy, modular construction, scale selection, permanent record, selective reference material, and color change.

A Vigicon demonstration includes:

- MAP GENERATION
- TARGET POSITIONING
- INTERCEPTS
- SPACE MONITORING
- INTELLIGENCE HAPPENINGS
- SELECTABLE REFERENCE MATERIAL
- STATUS BOARD
- SYMBOLGY IN VARIABLE FONT

For arrangements for a demonstration or further information on Vigicon, contact:

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1 Research Park, Palos Verdes Peninsula, California 90274

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